WHO child growth standards and the identification of severe acute malnutrition in infants and children

A Joint Statement
by the World Health Organization
and the United Nations Children's Fund

World Health Organization

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This statement presents the recommended cut-offs, summarizes the rationale for their adoption and advocates for their harmonized application in the identification of 6–60 month old infants and children for the management of severe acute malnutrition (SAM). It also reviews the implications on patient load, on discharge criteria and on programme planning and monitoring.

Using weight-for-height: WHO and UNICEF recommend the use of a cut-off for weight-for-height of below -3 standard deviations (SD) of the WHO standards to identify infants and children as having SAM. The commonly used cut-off is the same cut-off for both the new 2006 WHO child growth standards (WHO standards) as with the earlier National Center for Health Statistics (NCHS reference). The reasons for the choice of this cut-off are as follows:

1) Children below this cut-off have a highly elevated risk of death compared to those who are above;
2) These children have a higher weight gain when receiving a therapeutic diet compared to other diets, which results in faster recovery;
3) In a well-nourished population there are virtually no children below -3 SD (<1%).
4) There are no known risks or negative effects associated with therapeutic feeding of these children applying recommended protocols and appropriate therapeutic foods.

Using MUAC: WHO standards for mid-upper arm circumference (MUAC)-for-age show that in a well nourished population there are very few children aged 6–60 months with a MUAC less than 115 mm. Children with a MUAC less than 115 mm have a highly elevated risk of death compared to those who are above. Thus it is recommended to increase the cut-off point from 110 to 115 mm to define SAM with MUAC.

When using the WHO child growth standards to identify the severely malnourished among 6–60 month old children, the below -3SD cut-off for weight-for-height classifies two to four times as many children compared with the NCHS reference. The prevalence of SAM, i.e. numbers of children with SAM, based on weight-for-height below -3 SD of the WHO standards and those based on a MUAC cut-off of 115 mm, are very similar. The shift from NCHS to WHO child growth standards or the adoption of the new cut-off for MUAC will therefore sharply increase case loads. This has programmatic implications.

Recommendation

BOX 1. DIAGNOSTIC CRITERIA FOR SAM IN CHILDREN AGED 6–60 MONTHS

Indicator	Measure	Cut-off
Severe wasting (*2*)	Weight-for-height (*1*)	< -3 SD
Severe wasting (*2*)	MUAC	< 115 mm
Bilateral oedema (*3*)	Clinical sign	

1 Based on WHO Standards (www.who.int/childgrowth/standards)
2,3 Independent indicators of SAM that require urgent action

BOX 2. SAM MANAGEMENT			
Independent additional criteria	• No appetite • Medical complications		• Appetite • No medical complications
	↓		↓
Type of therapeutic feeding	**Facility-based**		**Community-based**
Intervention	F75→ F100/RUTF And 24 hour medical care		RUTF, basic medical care
Discharge criteria (Transition criteria from facility to community-based care)	Reduced oedema Good appetite (with acceptable[a] intake of RUTF)		15 to 20% weight gain

[a] Child eats at least 75% of their calculated RUTF ration for the day

Rationale

The WHO Child Growth Standards

In 2006, WHO published child growth standards for attained weight and height to replace the previously recommended 1977 NCHS/WHO child growth reference. These new standards are based on breastfed infants and appropriately fed children of different ethnic origins raised in optimal conditions and measured in a standardized way (*1*). The same cohort was used to produce standards of mid-upper arm circumference (MUAC) in relation to age (*2*). The new WHO growth standards confirm earlier observations that the effect of ethnic differences on the growth of infants and young children in populations is small compared with the effects of the environment. Studies have shown that there may be some ethnic differences among groups, just as there are genetic differences among individuals, but for practical purposes they are not considered large enough to invalidate the general use of the WHO growth standards population as a standard in all populations. These new standards have been endorsed by international bodies such as the United Nations Standing Committee on Nutrition (*3*), the International Union of Nutritional Sciences (*4*) and International Pediatric Association and adopted in more than 90 countries (*5*).

Diagnosing severe acute malnutrition (severe wasting or kwashiorkor or marasmic kwashiorkor)

In 1999, WHO defined severe malnutrition in children as a weight-for-height[1] below -3 SD[2] (based on NCHS reference) and/or the presence of oedema (*6*). Experts in a meeting in 2005, (*7,8*) recommended to add MUAC less than 110 mm (in 6 to 60 month old children) as an independent diagnostic criterion. Since the 2005 meeting, the WHO standards have been published and there is therefore a need to reassess diagnostic criteria including MUAC. The rationale for keeping the same cut-off for weight-for-height when defining severe acute malnutrition and for adjusting the MUAC cut-off up to 115 mm, based on the WHO standards is given below.

Risk of death and severe acute malnutrition

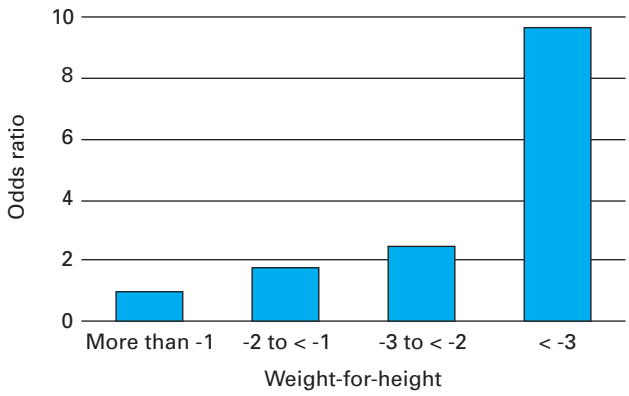
Following the release of the WHO child growth standards, the relationship between weight-for-

[1] When assessing weight-for-height, infants and children under 24 months of age should have their lengths measured lying down (supine). Children over 24 months of age should have their heights measured while standing. For simplicity, however, infants and children under 87 cm can be measured lying down (or supine) and those above 87 cm standing.

[2] A z-score is the number of standard deviations (SD) below or above the reference median value.

FIGURE 1

Odds ratio for mortality by weight-for-height. Adapted from reference 9



Note: reference category: children with a weight-for-height > -1 SD.

height and the risk of dying was reassessed in existing epidemiological studies.[1] This analysis showed that **children with a weight-for-height below -3 SD based on the WHO standards have a high risk of death** exceeding 9-fold that of children with a weight-for-height above -1 SD (**Figure 1**) (*9*). **Similar studies using MUAC as diagnostic criteria showed that the risk of dying is increased below 115 mm** (*10*). The elevated risk of death below these cut-offs requires the implementation of intensive nutritional and medical support.

Specificity of recommended cut-offs for diagnosing severe acute malnutrition

Weight-for-height below -3 SD is a highly specific criterion to identify severely acutely malnourished infants and children. Statistical theory shows that in a well-nourished population, only 0.13% of children will have a weight-for-height less than -3 SD, giving a specificity of more than 99%[2] for this cut-off.

With the release of the WHO standards for MUAC-for-age, the revision of the earlier recommended MUAC cut-off of 110 mm as an independent diagnostic criterion for severe acute malnutrition was necessary. **A higher cut-off of 115 mm is recommended as it will identify more infants and children as having severe acute malnutrition and still have a high specificity of more than 99% over the age range 6–60 months**.

Children below -3 SD of the WHO child growth standards benefit from therapeutic feeding

Currently, children with severe acute malnutrition are treated with special therapeutic foods, most commonly Ready-to-Use-Therapeutic Foods or F75 and F100 milk-based diets.

Data from Malawi suggests that infants and children 6–60 months of age with a weight-for-height above -3 SD of the NCHS reference also benefit from these therapeutic diets (*11*). The children who are above -3 SD of the NCHS reference but are below -3 SD of the WHO standards are most likely to benefit from therapeutic feeding.

Absence of risk and of negative consequences of therapeutic feeding

The current treatment protocols for managing severe acute malnutrition have no known risk, and minimise negative social consequences. **Less stringent admission criteria for therapeutic feeding should be promoted as earlier criteria did not identify all infants and children at high risk of mortality**. The below -3 SD cut-off based on the WHO growth standards for weight-for-height and the MUAC cut-off of 115 mm seem well adapted to current protocols.

Implications of using the WHO standards

Programmatic implications of the adoption of the WHO standards and changing the MUAC cut-off for identification of children with SAM

Using the new WHO standards in developing country situations results in a 2–4 times increase in the number of infants and children falling below -3 SD compared to using the former NCHS reference (*12,13*).

[1] The assessment of the risk of death associated with different degrees of wasting can be carried out only by community based longitudinal studies with a follow up of untreated malnourished children. This can be analysed only from a limited number of existing studies. For ethical reasons, these observational studies cannot be repeated, as an effective community-based treatment of severe acute malnutrition is now possible.

[2] Specificity is defined as the percentage of healthy individuals correctly diagnosed as healthy by the diagnostic test.

To better estimate the increase in patient load resulting from the adoption of the WHO growth standards, an analysis was performed on a data base comprising 560 different nutritional surveys conducted in 31 countries (*14*). The data set contained anthropometric measurements for more than 450 000 children aged 6–60 months. **The prevalence of SAM defined by weight-for-height below -3 SD of the WHO standards and by a MUAC cut-off of 115 mm were very similar**: 3.22% and 3.27% respectively. When using the NCHS reference, the prevalence of severe acute malnutrition was very similar when defined using weight-for-height below -3 SD and with MUAC below 110 mm: 1.48% and 1.49%, respectively.

It is important to note that using either the WHO standards or the NCHS reference, the cases selected using weight-for-height and MUAC were not the same. Only about 40% selected by the one criterion were also selected by the other. Part of the explanation is that children with a **low** MUAC tend to be younger than those with a weight-for-height less than -3 SD. The implications of these differences in terms of associated risk and response to treatment deserves further investigation and in the meantime **both should continue to be used as independent criteria for admission**.

Selection of patients according to the WHO standards is greatly facilitated by the use of look-up tables as shown in **Annex 1**.[1]

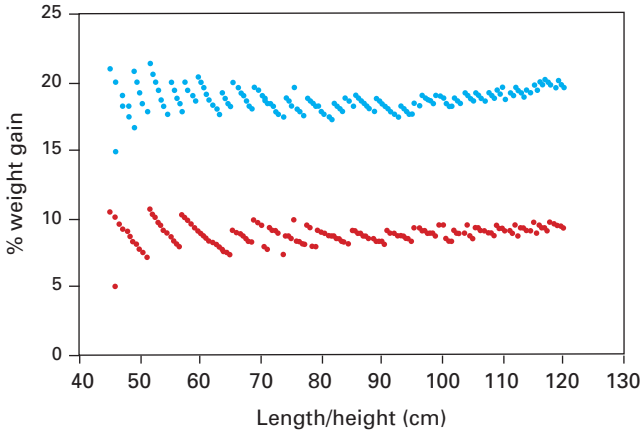
Redefining discharge criteria

Previously recommended discharge criteria based on a minimum weight-for-height are not applicable to programmes using MUAC as admission criteria, as some children selected using MUAC already fulfil these weight-for-height discharge criteria on admission into the programme. This is a concern especially with large scale community-based programmes relying extensively on MUAC as the criterion for admission.

It is recommended that the discharge criterion be based on percentage weight gain. Using a discharge criterion based on percentage weight gain has the advantage of being easy to apply to children admitted based on MUAC as well to those admitted on weight-for-height. This approach has the added advantage as it eliminates the need for repeated height measurements during treatment.

FIGURE 2

Percentage of weight gain needed to move from -3 to -2 or -1 SD with the WHO growth standards in relation to length or height



Data are shown for girls only. The top curve corresponds to a change up to -1 SD, the lower curve to a change up to -2.

Children with weight-for-height above -2 and below -1 SD, have a lower mortality risk than those below -3 SD. Those with a weight-for-height above -1 SD have an even lower risk of death (**Figure 1**). Reaching a weight-for-height above -2 or above - 1 SD can be used as a yardstick for defining discharge criteria. For children admitted at -3 SD weight-for-height defined by the WHO standards, a discharge at -2 SD and at -1 SD corresponds on average to a weight gain of 9% and 19% respectively. This percentage varies little for different lengths or heights (**Figure 2**). **For simplicity, it is possible to use 15 % weight gain as discharge criterion for all infants and children admitted to therapeutic feeding programmes (see Table 2 in annex)**. When weight-for-height is used as an admission criterion, it is advisable to continue to discharge children at weight-for-height -1 SD.

For children with oedema, the same discharge criterion should be applied using the weight after oedema has disappeared as the baseline. However, for children who have a weight-for-height above -3 SD or a MUAC above 115 mm once they are free from oedema, a discharge two weeks after the disappearance of oedema is usually sufficient to prevent relapse.

[1] More detailed tables are available on: http://www.who.int/childgrowth/standards/weight_for_length/en/index.html and http://www.who.int/childgrowth/standards/weight_for_height/en/index.html

The use of 15% weight gain as a discharge criterion is a general recommendation and can be adjusted up to 20% weight gain depending on the local situation. Discharge criteria can be adjusted when there are well functioning programmes that increase access to a high quality diet (supplementary feeding programmes, cash transfer, microcredit initiatives, support for improved agriculture etc.), the food security situation is good (access to nutrient dense family foods) and the number of children that can be treated by the health system is manageable. The implications of adjustment of the discharge criteria should be planned for in terms of longer lengths of stay and the resulting resource implications.

Monitoring therapeutic feeding programmes

Using weight-for-height based on the WHO standards or MUAC less than 115 mm as admission criteria will select younger and less severely wasted beneficiaries compared to using the NCHS reference for weight-for-height or MUAC less than 110 mm. These children selected by the new criteria will have a lower risk of death, and a lower weight gain (*15*). **The lower case fatality rates and slower weight gains of children selected by the new standards should be taken into account when monitoring the effectiveness of therapeutic feeding programmes**.

Planning therapeutic feeding programmes, interpretation of nutrition surveys

The percentage of children below -3 SD weight-for-height derived from nutrition surveys is commonly used to estimate the potential caseload of therapeutic feeding programmes. However, results based on cross-sectional surveys have certain limitations. First, the derived proportion of children 6–60 months of age with a weight-for-height below -3 SD and/or bilateral pitting oedema always has a wide confidence interval. Second, cross-sectional surveys estimate prevalence, whereas for programming purpose estimates of incidence or the number of new cases over a specified time period would be more suitable. Eventually, when MUAC is used as admission criterion, the proportion of children with a low weight-for-height does not correspond well with the proportion of children with low MUAC. Consequently there is often a mismatch between the case loads predicted by nutrition surveys and those actually observed. **To improve planning, it is therefore vital that the same criteria are used for estimating caseload as are being used for admission into programmes**. This means that in settings where MUAC will be used as the admission criterion for therapeutic feeding, especially at the community level, it is important to include MUAC assessment in the nutritional prevalence surveys. In addition, if possible, in all settings, information on the prevalence of wasting or severe acute malnutrition using weight-for-height from nutrition surveys should be complemented by observations of caseloads of ongoing programmes taking into account the programme coverage. In conclusion, **it is recommended that weight-for-height, MUAC and presence of bilateral oedema are assessed in nutrition surveys with prevalence estimates being derived from weight-for-height**.

Cost implications of the adoption of the WHO standards for therapeutic feeding programmes

The introduction of the WHO child growth standards and the revision of the MUAC cut-off to identify SAM children will increase the caseload for therapeutic feeding programmes, however at the same time the duration of treatment will decrease since more children will be detected earlier and in a less severe state. Increasing numbers has cost and human resource implications and may be difficult to introduce in resource-poor settings. However, available evidence suggests these changes will represent an improvement over current practices and using these admission criteria should be regarded as a priority to reach MDG 1 and 4.

ANNEX 1

Weight-for-Length Reference Card (below 87 cm)

Boys' weight (kg)					Length	Girls' weight (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Médian	(cm)	Médian	-1 SD	-2 SD	-3 SD	-4 SD
1.7	1.9	2.0	2.2	2.4	45	2.5	2.3	2.1	1.9	1.7
1.8	2.0	2.2	2.4	2.6	46	2.6	2.4	2.2	2.0	1.9
2.0	2.1	2.3	2.5	2.8	47	2.8	2.6	2.4	2.2	2.0
2.1	2.3	2.5	2.7	2.9	48	3.0	2.7	2.5	2.3	2.1
2.2	2.4	2.6	2.9	3.1	49	3.2	2.9	2.6	2.4	2.2
2.4	2.6	2.8	3.0	3.3	50	3.4	3.1	2.8	2.6	2.4
2.5	2.7	3.0	3.2	3.5	51	3.6	3.3	3.0	2.8	2.5
2.7	2.9	3.2	3.5	3.8	52	3.8	3.5	3.2	2.9	2.7
2.9	3.1	3.4	3.7	4.0	53	4.0	3.7	3.4	3.1	2.8
3.1	3.3	3.6	3.9	4.3	54	4.3	3.9	3.6	3.3	3.0
3.3	3.6	3.8	4.2	4.5	55	4.5	4.2	3.8	3.5	3.2
3.5	3.8	4.1	4.4	4.8	56	4.8	4.4	4.0	3.7	3.4
3.7	4.0	4.3	4.7	5.1	57	5.1	4.6	4.3	3.9	3.6
3.9	4.3	4.6	5.0	5.4	58	5.4	4.9	4.5	4.1	3.8
4.1	4.5	4.8	5.3	5.7	59	5.6	5.1	4.7	4.3	3.9
4.3	4.7	5.1	5.5	6.0	60	5.9	5.4	4.9	4.5	4.1
4.5	4.9	5.3	5.8	6.3	61	6.1	5.6	5.1	4.7	4.3
4.7	5.1	5.6	6.0	6.5	62	6.4	5.8	5.3	4.9	4.5
4.9	5.3	5.8	6.2	6.8	63	6.6	6.0	5.5	5.1	4.7
5.1	5.5	6.0	6.5	7.0	64	6.9	6.3	5.7	5.3	4.8
5.3	5.7	6.2	6.7	7.3	65	7.1	6.5	5.9	5.5	5.0
5.5	5.9	6.4	6.9	7.5	66	7.3	6.7	6.1	5.6	5.1
5.6	6.1	6.6	7.1	7.7	67	7.5	6.9	6.3	5.8	5.3
5.8	6.3	6.8	7.3	8.0	68	7.7	7.1	6.5	6.0	5.5
6.0	6.5	7.0	7.6	8.2	69	8.0	7.3	6.7	6.1	5.6
6.1	6.6	7.2	7.8	8.4	70	8.2	7.5	6.9	6.3	5.8
6.3	6.8	7.4	8.0	8.6	71	8.4	7.7	7.0	6.5	5.9
6.4	7.0	7.6	8.2	8.9	72	8.6	7.8	7.2	6.6	6.0
6.6	7.2	7.7	8.4	9.1	73	8.8	8.0	7.4	6.8	6.2
6.7	7.3	7.9	8.6	9.3	74	9.0	8.2	7.5	6.9	6.3
6.9	7.5	8.1	8.8	9.5	75	9.1	8.4	7.7	7.1	6.5
7.0	7.6	8.3	8.9	9.7	76	9.3	8.5	7.8	7.2	6.6
7.2	7.8	8.4	9.1	9.9	77	9.5	8.7	8.0	7.4	6.7
7.3	7.9	8.6	9.3	10.1	78	9.7	8.9	8.2	7.5	6.9
7.4	8.1	8.7	9.5	10.3	79	9.9	9.1	8.3	7.7	7.0
7.6	8.2	8.9	9.6	10.4	80	10.1	9.2	8.5	7.8	7.1
7.7	8.4	9.1	9.8	10.6	81	10.3	9.4	8.7	8.0	7.3
7.9	8.5	9.2	10.0	10.8	82	10.5	9.6	8.8	8.1	7.5
8.0	8.7	9.4	10.2	11.0	83	10.7	9.8	9.0	8.3	7.6
8.2	8.9	9.6	10.4	11.3	84	11.0	10.1	9.2	8.5	7.8
8.4	9.1	9.8	10.6	11.5	85	11.2	10.3	9.4	8.7	8.0
8.6	9.3	10.0	10.8	11.7	86	11.5	10.5	9.7	8.9	8.1

Weight-for-Height Reference Card (87 cm and above)

Boys' weight (kg)					Height	Girls' weight (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Médian	(cm)	Médian	-1 SD	-2 SD	-3 SD	-4 SD
8.9	9.6	10.4	11.2	12.2	87	11.9	10.9	10.0	9.2	8.4
9.1	9.8	10.6	11.5	12.4	88	12.1	11.1	10.2	9.4	8.6
9.3	10.0	10.8	11.7	12.6	89	12.4	11.4	10.4	9.6	8.8
9.4	10.2	11.0	11.9	12.9	90	12.6	11.6	10.6	9.8	9.0
9.6	10.4	11.2	12.1	13.1	91	12.9	11.8	10.9	10.0	9.1
9.8	10.6	11.4	12.3	13.4	92	13.1	12.0	11.1	10.2	9.3
9.9	10.8	11.6	12.6	13.6	93	13.4	12.3	11.3	10.4	9.5
10.1	11.0	11.8	12.8	13.8	94	13.6	12.5	11.5	10.6	9.7
10.3	11.1	12.0	13.0	14.1	95	13.9	12.7	11.7	10.8	9.8
10.4	11.3	12.2	13.2	14.3	96	14.1	12.9	11.9	10.9	10.0
10.6	11.5	12.4	13.4	14.6	97	14.4	13.2	12.1	11.1	10.2
10.8	11.7	12.6	13.7	14.8	98	14.7	13.4	12.3	11.3	10.4
11.0	11.9	12.9	13.9	15.1	99	14.9	13.7	12.5	11.5	10.5
11.2	12.1	13.1	14.2	15.4	100	15.2	13.9	12.8	11.7	10.7
11.3	12.3	13.3	14.4	15.6	101	15.5	14.2	13.0	12.0	10.9
11.5	12.5	13.6	14.7	15.9	102	15.8	14.5	13.3	12.2	11.1
11.7	12.8	13.8	14.9	16.2	103	16.1	14.7	13.5	12.4	11.3
11.9	13.0	14.0	15.2	16.5	104	16.4	15.0	13.8	12.6	11.5
12.1	13.2	14.3	15.5	16.8	105	16.8	15.3	14.0	12.9	11.8
12.3	13.4	14.5	15.8	17.2	106	17.1	15.6	14.3	13.1	12.0
12.5	13.7	14.8	16.1	17.5	107	17.5	15.9	14.6	13.4	12.2
12.7	13.9	15.1	16.4	17.8	108	17.8	16.3	14.9	13.7	12.4
12.9	14.1	15.3	16.7	18.2	109	18.2	16.6	15.2	13.9	12.7
13.2	14.4	15.6	17.0	18.5	110	18.6	17.0	15.5	14.2	12.9
13.4	14.6	15.9	17.3	18.9	111	19.0	17.3	15.8	14.5	13.2
13.6	14.9	16.2	17.6	19.2	112	19.4	17.7	16.2	14.8	13.5
13.8	15.2	16.5	18.0	19.6	113	19.8	18.0	16.5	15.1	13.7
14.1	15.4	16.8	18.3	20.0	114	20.2	18.4	16.8	15.4	14.0
14.3	15.7	17.1	18.6	20.4	115	20.7	18.8	17.2	15.7	14.3
14.6	16.0	17.4	19.0	20.8	116	21.1	19.2	17.5	16.0	14.5
14.8	16.2	17.7	19.3	21.2	117	21.5	19.6	17.8	16.3	14.8
15.0	16.5	18.0	19.7	21.6	118	22.0	19.9	18.2	16.6	15.1